Stochastic Combinatorial Optimization
Proposal for a Ph.D Thesis

Domain: Algorithms, graphs, combinatorics

Keywords: Combinatorial optimization, Semidefinite programming, stochastic optimization, approximation

Abstract

Abstract The research topic is Semidefinite Programming and Combinatorial Stochastic Optimization, which is at the crossroads between discrete mathematics, graph theory, optimization and computer science. The project aims at developing new and fast methods for finding exact or approximate solutions to hard combinatorial stochastic optimization problems. Semidefinite programming is a generalization of classic linear programming dealing with optimization problems over positive semidefinite matrices. Working on that and related topics may be part of the PhD research project, as well as algorithmic and computational studies to practical applications amongst all telecommunications network design problems, risk modelling in finance and electricity planning problems.

Context

Semidefinite programming is a generalization of classic linear programming dealing with optimization problems over positive semidefinite matrices. Recently, there has been increasing interest in the use of semidefinite programming in solving combinatorial optimization problems. This started with the seminal work of Lovasz (1979) on the so-called theta function. This also led Grötchel, Lovasz and Schrijver (1981) to develop a polynomial time algorithm to solve the maximum stable set problem for perfect graphs. More recently, Goemens and Williamson (1995) improved approximation algorithms for the max cut and related problems using semidefinite programming.

Stochastic combinatorial optimization is a recent topic in optimization, and has met a little interest in the optimization and computer science commnities. This is especially due to grouping two difficult areas, namely combinatorial and stochastic optimization.

Objectives

The objcetives are four fold:

1. Extend max-k-flow problems to multicommodity problems.
2. Derive semidefinite relaxations in order to build performant polynomial algorthms.
3. Consider the capacities of the edges as random variables, and apply 1. and 2. to the obtained stochastic combinatorial problems.
4. Apply the previous obtained results to survivable network design problems.

Work program

The main step correpond the 4 objectives described above.
Extra information Prerequisite - Research master in computer science or applied mathematics

Prerequisites

- Good knowledge of the operations research and probability/statistics fields
- Good programming skills (C, C++)

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Expected funding

Candidates are expected to apply for an institutional research grant at the University of Paris Sud.
See the website of Ecole Doctorale en Informatique: http://edips.lri.fr/

Expected starting date: October 2011

Candidates

Mr. Jean-François Baffier is our favourite candidate for this Ph.D work. Mr. Baffier is preparing his Master degree in Computer Science at the University of Paris Sud. He is preparing his master thesis in Japan under the supervision of Professor Imai in Combinatorial Optimization. He is expected to have an excellent combinatorial optimization education. He is an excellent student and has got very high score in the Master exams.